Comparison of Maine Learning Results Measures for Science Assessment (Chapter 131) to NGSS Disciplinary Core Ideas
Prepared by Anita Bernhardt, May 2013

This document compares the Maine Learning Results science standards (performance indicators and descriptors) to the NGSS (performance expectations). Developing a comparison between the current Maine standards, or any state standards for science, and the NGSS is an inherently difficult task. The task is difficult because the performance indicators of the NGSS incorporate the three dimension of the Framework for K-12 Science Education: the disciplinary core ideas (core content) as well as practices and crosscutting concepts. The current Maine standards are not written in a comparable integrated manner. The Maine standards for science do contain sections that are similar to but not as extensive as the practices and crosscutting concepts found in the NGSS. This comparison of the MLR standards (performance indicators and descriptors) to the NGSS (performance expectations) maps each against the disciplinary core ideas identified in the Framework for K-12 Science Education. The Framework was developed by the National Research Council to serve as the guide for the development of the NGSS.

In this document, blue highlighting indicates a disciplinary core idea or performance expectation not currently found in the 2007 Maine Learning Results or assumed not to be part of the ideas intended by the language of the 2007 Maine standards. Pink highlighting indicates current Maine content that has moved down in grade span. Yellow highlighting indicates current Maine content that has moved up in grade span. Green highlighting indicates current Maine content that exists in the standards but is not currently assessed. Items without highlighting are considered reasonably aligned to the core disciplinary idea and included in the current interpretation of the meaning of the 2007 MLR. Grade span K-2 overall has the most change BUT it is not measured in large-scale assessment. Grade span 3-5 has some significant pockets of change related to ideas about energy and there are some concepts from grade span 6-8 that have moved down to 3-5. Grade span 6-8 has pockets of new information. In many instances the skeleton of the disciplinary core idea that exists in the Maine standards is being fleshed out. There is the least amount of difference at the grades span 9-12.

As noted below, the NGSS are different from the current 2007 MLR especially because the NGSS integrates the practices, crosscutting concepts and core disciplinary ideas into the performance expectations. The practices, crosscutting concepts and core disciplinary ideas are the three dimensions of each performance expectation. One can think of them in the following manner, the practices are comparable to enhanced inquiry; the crosscutting concepts are like the themes in our current standards (systems thinking, models, …) and the disciplinary core ideas are the essential science concepts. This comparison focuses only on the alignment between the 2007 MLR and the NGSS as relates to the core disciplinary ideas.

Changes in the MEA science needed for alignment to the NGSS:
The Maine Education Assessment for Science, the science portion of the Maine Comprehensive Assessment System of the Maine DOE, will need to change in several ways to become aligned to the NGSS. The most obvious shifts relate to the content focus for the assessment items. The details of these shifts, which include the identification of new content as well as up and down grade span shifts of existing content, can be found in the chart below. The MEA science will need to adjust in additional ways beyond content changes. To be aligned to the NGSS, the MEA Science will need to incorporate more assessment items that are constructed response items or add performance assessment and simulations and rely on fewer multiple-choice items The MEA Science will also need to incorporate more Depth of Knowledge 3 (complex reasoning) items and fewer Depth of Knowledge 1 (recall) items. To incorporate the practices MEA assessment will also need to incorporate significant numbers of items that rely on data that students can use as the basis for developing and defending claims, will need to require students to use and develop models to explain and predict, and will need to ask students to use mathematical and computation thinking in the context of science assessment items. To incorporate the crosscutting concepts the MEA assessment will need to incorporate items that require students to use patterns, and apply understandings of systems and energy. The state blueprint for the development of the MEA science assessment does not currently require the integration of practices and crosscutting concepts as part of the development of the science assessment nor does it prohibit their inclusion.

	Disciplinary Core Ideas	NGSS Performance Expectations	Notes specific to Disciplinary Core Ideas:
Grade Span K-2			
K-2 Describe how the sun and moon seem to move across the sky. K-2 Describe the changes in the appearance of the moon from day to day.	K-2 ESS 1 Patterns of movement of the sun, moon, and stars as seen from Earth can be observed, described, and predicted. Some events on Earth occur very quickly; others can occur very slowly.	1 –ESS Use observations of the sun, moon, and stars to describe patterns that can be predicted. 1 –ESS Make observations at different times of year to relate the amount of daylight to the time of year. 2 –ESS Make observations from media to construct an evidence-based account that Earth events can occur quickly or slowly.	Students are not tested at grade span K-2 as part of large-scale state assessment. Understanding place is important foundational knowledge for understanding Earth as a system. Through out the NGSS we see increased attention to Earth as a system and the interactions of organisms (including humans) with the living environment.
K-2 Describe the way in which weather changes over months. K-2 Describe what happens to water left in an open container as compared to water left in a closed container. 3-5 Students describe ways organisms depend upon, interact within, and change the living and non-living environment as well as ways the environment affects organisms.	K-2 ESS2 Wind and water change the shape of the land. Maps show where things are located. One can map the shapes and kinds of land and water in any area. Water is found in many types of places and in different forms on Earth. Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time. Plants and animals can change their local environment.	K –ESS Use and share observations of local weather conditions to describe patterns over time. K –ESS Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. 2–ESS Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.* 2 –ESS Develop a model to represent the shapes and kinds of land and bodies of water in an area. 2 –ESS Obtain information to identify where water is found on Earth and that it can be solid or liquid.	
3-5 Students describe ways organisms depend upon, interact within, and change the living and non-living environment as well as ways the environment affects organisms.	K-2 ESS3 Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. In a region, some kinds of severe weather are more likely than others. Forecasts allow communities to prepare for severe weather. Things people do can affect the environment but they can make choices to reduce their impacts.	K –ESS Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. K –ESS Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.* K –ESS Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.*	

K-2 Students describe similarities and differences in the observable behaviors, features, and needs of plants and animals. K-2 Describe similarities and differences in the way plants and animals look and the things that they do. K-2 Describe some features of plants and animals that help them live in different environments. K-2 Students understand how plants and animals depend on each other and the environment in which they live. K-2 Explain that animals use plants and other animals for food, shelter, and nesting. K-2 Identify structures that help organisms do things to stay alive. K-2 List the basic things that most organisms need to survive. K-2 Students describe parts and wholes of living things, their basic needs, and the structures and processes that help them stay alive.	K-2 LS 1 All organisms have external parts that they use to perform daily functions. Parents and offspring often engage in behaviors that help the offspring survive. Animals obtain food they need from plants or other animals. Plants need water and light. Animals sense and communicate information and respond to inputs with behaviors that help them grow and survive.	K-LS Use observations to describe patterns of what plants and animals (including humans) need to survive. 1-LS Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.* 1-LS Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. 1-LS Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. 2-LS Plan and conduct an investigation to determine if plants need sunlight and water to grow. 2-LS Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*	The NGSS decreased the expectations for this grade span related to life science.
	K-2 LS 2 Content found other places or N/A		
K-2 Students describe the cycle of birth, development, and death in different organisms and the ways in which organisms resemble their parents. K-2 Give examples of how organisms are like their parents and not like them. K-2 Describe some organisms' features that allow the organisms to live in places others cannot. K-2 Students understand how plants and animals depend on each other and the environment in which they live.	K-2 LS 3 Young organisms are very much, but not exactly, like their parents and also resemble other organisms of the same kind. Living things can survive only where their needs are met. If some places are too hot or too cold or have too little water or food, plants and animals may not be able to live there. A range of different organisms lives in different places.	2-LS Make observations of plants and animals to compare the diversity of life in different habitats.	

K-2 Explain that animals use plants and other animals for food, shelter, and nesting. K-2 Compare different animals and plants that live in different environments of the world. K-2 Compare different animals and plants that live in different environments of the world.			
K-2 Students use observable characteristics to describe objects and materials and changes to physical properties of materials. K-2 Describe objects in terms of what they are made of and their physical properties. K-2 Describe changes in properties of materials when mixed, heated, frozen, or cut.	K-2 PS 1 Matter exists as different substances that have observable different properties. Different properties are suited to different purposes. Objects can be built up from smaller parts. Heating and cooling substances cause changes that are sometimes reversible and sometimes not.	2-PS Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. 2-PS Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* 2-PS Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. 2-PS Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.	The Maine standards incorporates energy as part of part of the physical science standards. The NGSS treats energy as a discrete idea.
K-2 Students describe how objects move in different ways. K-2 Describe different ways things move and what it takes to start objects moving, keep objects moving, or stop objects. 3-5 Students summarize how various forces affect the motion of objects.	K-2 PS 2 Pushes and pulls can have different strengths and directions, and can change the speed or direction of its motion or start or stop it. A change in motion of an object can depend on the effects of multiple forces.	K-PS Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. K-PS Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*	
K-2 Explain that the sun warms the air, water, and land. 3-5 Students summarize how various forces affect the motion of objects.	K-2 PS3 Bigger pushes and pulls cause bigger changes in an object's motion or shape. Sunlight warms Earth's surface.	K-PS Make observations to determine the effect of sunlight on Earth's surface. K-PS Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.*	
K-2 Give examples of things that make	K-2 PS4	1-PS Plan and conduct investigations to	

sound by vibrating.	Sound can make matter vibrate, and vibrating matter can make sound. Objects can be seen only when light is available to illuminate them. People use devices to send and receive information.	provide evidence that vibrating materials can make sound and that sound can make materials vibrate. 1-PS Make observations to construct an evidence-based account that objects can be seen only when illuminated. 1-PS Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. 1-PS Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*	
NOT currently ASSESSED on MEA but included in 2007 MLR K-2 Students use a simple design process and basic tools and materials to solve a problem or create a product. K-2 Describe a design problem in their own words. K-2 Propose a way to build something or cause something to work better. K-2 Use suitable tools, materials, safe techniques, and measurements to implement a proposed solution to a design problem. K-2 Judge how well a product or design solved a problem. K-2 Present a design or solution to a problem using oral, written, or pictorial means of communication.	K-2 Engineering Design	K-2 ETS Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. K-2 ETS Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. K-2 ETS Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	Engineering Design in not currently assessed in the MEA but is a part of the Maine science standards.
Grade Span 3-5			
3-5 Recognize that the sun is a star and is similar to other stars in the universe. 3-5 Students describe the positions and apparent motions of different objects in and beyond our solar system and how these objects can be viewed from Earth. 3-5 Show the locations of the sun, Earth,	3-5 ESS 1 Stars range greatly in size and distance from Earth and this can explain their relative brightness. The Earth's orbit and rotation, and the orbit of the moon around the Earth cause observable patterns.	4ESS Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. 5ESS Support an argument that the apparent brightness of the sun and stars is due to their relative distances from	The NGSS includes understanding landscape features.

moon, and planets and their orbits. 3-5 Observe and report on observations that the sun appears to move across the sky in the same way every day, but its path changes slowly over the seasons.	Certain features on Earth can be used to order events that have occurred in a landscape.	Earth. 5ESS Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	
3-5 Describe the various forms water takes in the air and how that relates to weather. 3-5 Explain how wind, waves, water, and ice reshape the surface of Earth. 3-5 Students describe the properties of Earth's surface materials, the processes that change them, and cycles that affect the Earth. 3-5 Explain the effects of the rotation of Earth on the day/night cycle, and how that cycle affects local temperature. 3-5 Students identify and describe the influences of science and technology on people and the environment. (NA) 3-5 Students describe ways organisms depend upon, interact within, and change the living and non-living environment as well as ways the environment affects organisms. 3-5 Explain how organisms can affect the environment in different ways. MS Describe Earth Systems - biosphere, atmosphere, hydrosphere and lithosphere - and cycles and interactions within them (including water moving among and between them, rocks forming and transforming, and weather formation). Give examples of abrupt changes and slow changes in Earth Systems. MS Describe significant Earth resources and how their limited supply affects how they are used.	3-5 ESS 2 Four major Earth systems interact. Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around. Earth's physical features occur in patterns, as do earthquakes and volcanoes. Maps can be used to locate features and determine patterns in those events. Most of Earth's water is in the ocean and much of the Earth's fresh water is in glaciers or underground. Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed. Living things can affect the physical characteristics of their environment.	3 ESS Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. 3 ESS Obtain and combine information to describe climates in different regions of the world. 3ESS Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.* 4 ESS Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. 4ESS Analyze and interpret data from maps to describe patterns of Earth's features. 5ESS Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. 5ESS Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.	

NOT currently ASSESSED on MEA but included in 2007 MLR 3-5 Explain that natural resources are limited, and that reusing, recycling, and reducing materials and using renewable resources is important. 3-5 Explain how scientific and technological information can help people make safe and healthy decisions. 3-5 Give examples of changes in the environment caused by natural or man-made influences.	3-5 ESS 3 Energy and fuels humans use are derived from natural sources and their use affects the environment. Some resources are renewable over time, others are not. A variety of hazards result from natural processes; humans cannot eliminate hazards but can reduce their impacts. Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Students describe things society does to protect Earth's resources and environments. Humans and other organisms will be affected in many different ways if Earth's global mean temperature continues to rise.	4 ESS Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. 4ESS Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* 5ESS Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	Human interaction with the environment is not currently assessed in the MEA but is a part of the Maine science standards.
3-5 Students compare living things based on their behaviors, external features, and environmental needs. 3-5 Describe how living things can be sorted in many ways, depending on which features or behaviors are used to sort them, and apply this understanding to sort living things. 3-5 Describe the changes in external features and behaviors of an organism during its life cycle. 3-5 Explain how the food of most animals can be traced back to plants and how animals use food for energy and repair.	3-5 LS 1 Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction. Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles. Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and process matter and obtain energy from sunlight, which is used to maintain conditions necessary for survival. Different sense receptors are specialized for particular kinds of information; Animals use their perceptions and memories to guide their actions.	3 LS Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death. 4 LS Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. 4 LS Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. 5 LS Support an argument that plants get the materials they need for growth chiefly from air and water.	NGSS adds information processing in animals and the influence of the environment on the development of organisms.
3-5 Explain how changes in an organism's habitat can influence its survival. 3-5 Describe that organisms all over the	3-5 LS 2 The food of almost any animal can be traced back to plants. Organisms are related in food webs in which some	3 LS Construct an argument that some animals form groups that help members survive. 5 LS Develop a model to describe the	

Earth are living, dying, and decaying and new organisms are being produced by the old ones. 3-5 Describe some of the ways in which organisms depend on one another, including animals carrying pollen and dispersing seeds. 3-5 Explain how the food of most animals can be traced back to plants and how animals use food for energy and repair.	animals eat plants for food and other animals eat the animals that eat plants, while decomposers restore some materials back to the soil. Matter cycles between the air and soil and among organisms as they live and die. When the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. Being part of a group helps animals obtain food, defend themselves, and cope with changes.	movement of matter among plants, animals, decomposers, and the environment.	
3-5 Students describe characteristics of organisms, and the reasons why organisms differ from or are similar to their parents. 3-5 Name some likenesses between children and parents that are inherited, and some that are not. 3-5 Explain that in order for offspring to look like their parents, information related to inherited likenesses must be handed from parents to offspring in a reliable manner.	3-5 LS 3 Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.	3 LS Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. 3 LS Use evidence to support the explanation that traits can be influenced by the environment.	
3-5 Students describe the fossil evidence and present explanations that help us understand why there are differences among and between present and past organisms. 3-5 Explain advantages and disadvantages gained when some individuals of the same kind are different in their characteristics and behavior. 3-5 Compare fossils to one another and to living organisms according to their similarities and differences. 3-5 Students compare living things based on their behaviors, external features, and	3-5 LS 4 Some living organisms resemble organisms that once lived on Earth. Fossils provide evidence about the types of organisms and environments that existed long ago. Differences in characteristics between individuals of the same species provide advantages in surviving and reproducing. Particular organisms can only survive in particular environments. Populations of organisms live in a variety of habitats. Change in those habitats affects the organisms living there.	3 LS Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. 3 LS Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. 3 LS Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. 3 LS Make a claim about the merit of a	

environmental needs. 3-5 Describe how living things can be sorted in many ways, depending on which features or behaviors are used to sort them, and apply this understanding to sort living things. 3-5 Explain how changes in an organism's habitat can influence its survival.		solution to a problem caused when the environment changes and the types of plants and animals that live there may change.*	
3-5 Students describe properties of objects and materials before and after they undergo a change or interaction. 3-5 Illustrate how many different substances can be made from a small number of basic ingredients. 3-5 Describe properties of original materials, and the new material(s) formed, to demonstrate that a change has occurred. 3-5 Explain that the properties of a material may change but the total amount of material remains the same. 3-5 Explain that materials can be composed of parts too small to be seen without magnification. 3-5 Describe how the heating and cooling of water and other materials can change the properties of the materials. 3-5 Describe how the weight of an object compares to the sum of the weight of its parts.	3-5 PS 1 Because matter exists as particles that are too small to see, matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials. Chemical reactions that occur when substances are mixed can be identified by the emergence of substances with different properties; the total mass remains the same.	5 PS Develop a model to describe that matter is made of particles too small to be seen. 5 PS Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. 5 PS Make observations and measurements to identify materials based on their properties. 5 PS Conduct an investigation to determine whether the mixing of two or more substances results in new substances.	The Maine standards incorporated energy as part of part of the physical science standards. The NGSS treats energy as a discrete idea and develops that idea significantly at grade span 3-5.
3-5 Students summarize how various forces affect the motion of objects. 3-5 Predict the effect of a given force on the motion of an object. 3-5 Describe how fast things move by how long it takes them to go a certain distance.	3-5 PS 2 The effect of unbalanced forces on an object results in a change of motion. Patterns of motion can be used to predict future motion. Some forces act through contact, some forces act even when the objects are not in contact. The	3 PS Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. 3 PS Make observations and/or measurements of an object's motion to provide evidence that a pattern can be	

3-5 Describe the path of an object. 3-5 Give examples of how gravity, magnets, and electrically charged materials push and pull objects. MS Describe the effect of gravity on objects on Earth. MS Describe and apply an understanding of the effects of multiple forces on an object, and how unbalanced forces will cause changes in the speed or direction.	gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	used to predict future motion. 3 PS Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. 3 PS Define a simple design problem that can be solved by applying scientific ideas about magnets.* 5 PS Support an argument that the gravitational force exerted by Earth on objects is directed down.	
3-5 Recognize that the sun is the source of Earth's surface heat and light energy.	3-5 PS 3 Moving objects contain energy. The faster the object moves, the more energy it has. Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form. When objects collide, contact forces transfer energy so as to change the objects' motions. Energy can be "produced," "used," or "released" by converting stored energy. Plants capture energy from sunlight, which can later be used as fuel or food. Waves are regular patterns of motion, which can be made in water by disturbing the surface. Waves of the same type can differ in amplitude and wavelength. Waves can make objects move. Object can be seen only when light reflected from their surface enters our eyes. Patterns can encode, send, receive and decode information.	4 PS Use evidence to construct an explanation relating the speed of an object to the energy of that object. 4 PS Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. 4 PS Ask questions and predict outcomes about the changes in energy that occur when objects collide. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.* 4 PS Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. 4 PS Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. Generate and compare multiple solutions that use patterns to transfer information.* 5 PS Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.	
NOT currently ASSESSED on MEA but included in 2007 MLR 3-5 Students use a design process,	Engineering Design	3-5ETS Define a simple design problem reflecting a need or a want that includes specified criteria for success and	Engineering Design in not currently assessed in the MEA but is a part of the Maine science standards.

simple tools, and a variety of materials to solve a problem or create a product, recognizing the constraints that need to be considered. 3-5 Identify and explain a simple design problem and a solution related to the problem. 3-5 Propose a solution to a design problem that recognizes constraints including cost, materials, time, space, or safety. 3-5 Use appropriate tools, materials, safe techniques, and quantitative measurements to implement a proposed solution to a design problem. 3-5 Balance simple constraints in carrying out a proposed solution to a design problem. 3-5 Evaluate their own design results, as well as those of others, using established criteria. 3-5 Modify designs based on results of evaluations. 3-5 Present the design problem, process, and design or solution using oral, written, and/or pictorial means of communication.		constraints on materials, time, or cost. 3-5ETS Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5ETS Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	
Grade Span 6-8: MIDDLE SCHOOL			
MS Students explain the movements and describe the location, composition, and characteristics of our solar system and universe, including planets, the sun, and galaxies. MS Describe the different kinds of objects in the solar system including planets, sun, moons, asteroids, and comets. MS Explain the motions that cause days, years, phases of the moon, and eclipses. MS Describe the location of our solar system in its galaxy and explain that other galaxies exist and that they include stars and planets.	MS ESS 1 The solar system is part of the Milky Way, which is one of many billions of galaxies. The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons. Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history.	MS Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. MS Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. MS Analyze and interpret data to determine scale properties of objects in the solar system. MS Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old	

MS Explain how the tilt of Earth's rotational axis relative to the plane of its yearly orbit around the sun affects the day length and sunlight intensity to cause seasons.		history.	
MS Students describe the various cycles, physical and biological forces and processes, position in space, energy transformations, and human actions that affect the short-term and long-term changes to the Earth. MS Give several reasons why the climate is different in different regions of the Earth. MS Describe Earth Systems - biosphere, atmosphere, hydrosphere and lithosphere - and cycles and interactions within them (including water moving among and between them, rocks forming and transforming, and weather formation).	MS ESS 2 Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes. Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. Maps are used to display evidence of plate movement. Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features. Complex interactions determine local weather patterns and influence climate, including the role of the ocean.	MS Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. MS Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. MS Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. MS Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. MS Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. MS Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.	
NOT currently ASSESSED on MEA but included in 2007 MLR MS Describe significant Earth resources and how their limited supply affects how they are used. Students identify and describe the role of science and technology in addressing personal and societal challenges. MS Describe how science and technology	MS ESS 3 Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes. Mapping the history of natural hazards in a region and understanding related	MS Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. MS Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of	

can help address societal challenges including population, natural hazards, sustainability, personal health and safety, and environmental quality. MS Identify personal choices that can either positively or negatively impact society including population, ecosystem sustainability, personal health, and environmental quality. MS Identify factors that influence the development and use of science and technology.	geological forces. Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth. Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.	technologies to mitigate their effects. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	
MS Explain the relationship among cells, tissues, organs, and organ systems, including how tissues and organs serve the needs of cells and organisms. MS Students describe the hierarchy of organization and function in organisms, and the similarities and differences in structure, function, and needs among and within organisms. MS Explain that all living things are composed of cells numbering from just one to millions. MS Describe the basic functions of organisms carried out within cells including the extracting of energy from food and the elimination of wastes. MS Compare the structures, systems, and interactions that allow single-celled organisms and multi-celled plants and animals, including humans, to defend themselves, acquire and use energy, self-regulate, reproduce, and coordinate movement. MS Compare physical characteristics that differentiate organisms into groups (including plants that use sunlight to make their own food, animals that consume	LS 1 All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions. Animals engage in behaviors that increase the odds of reproduction. An organism's growth is affected by both genetic and environmental factors. Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy. Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain; The signals are then processed in the brain, resulting in immediate behavior or memories.	MS Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. MS Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. MS Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. MS Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. MS Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. MS Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as	NGSS adds information processing in animals and makes connection of biodiversity to habitat health, and the connection between mutation and organism traits.

energy-rich food, and organisms that cannot easily be classified as either). MS Describe how external and internal structures of animals and plants contribute to the variety of ways organisms are able to find food and reproduce. MS Students examine how the characteristics of the physical, non-living (abiotic) environment, the types and behaviors of living (biotic) organisms, and the flow of matter and energy affect organisms and the ecosystem of which they are part. MS Students describe the general characteristics and mechanisms of reproduction and heredity in organisms, including humans, and ways in which organisms are affected by their genetic traits.		this matter moves through an organism. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.	
MS Students examine how the characteristics of the physical, non-living (abiotic) environment, the types and behaviors of living (biotic) organisms, and the flow of matter and energy affect organisms and the ecosystem of which they are part. MS List various kinds of resources within different biomes for which organisms compete. MS Describe ways in which two types of organisms may interact (including competition, predator/prey, producer/consumer/decomposer, parasitism, and mutualism) and describe the positive and negative consequences of such interactions. MS Describe the source and flow of energy in the two major food webs, terrestrial and marine.	LS 2 Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. Competitive, predatory, and mutually beneficial interactions vary across ecosystems but the patterns are shared. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem. Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations.	MS Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. MS Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. MS Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. MS Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. MS Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*	

MS Describe how matter and energy change from one form to another in living things and in the physical environment. MS Explain that the total amount of matter in the environment stays the same even as its form and location change. MS Describe how science and technology can help address societal challenges including population, natural hazards, sustainability, personal health and safety, and environmental quality. (NA)	The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.		
MS Students describe the general characteristics and mechanisms of reproduction and heredity in organisms, including humans, and ways in which organisms are affected by their genetic traits. MS Explain that sexual reproduction includes fertilization that results in the inclusion of genetic information from each parent and determines the inherited traits that are a part of every cell. MS Describe asexual reproduction as a process by which all genetic information comes from one parent and determines the inherited traits that are a part of every cell. HS Describe the relationship among DNA, protein molecules, and amino acids in carrying out the work of cells and how this is similar among all organisms.	LS 3 Genes chiefly regulate a specific protein, which affect an individual's traits. In sexual reproduction, each parent contributes half of the genes acquired by the offspring resulting in variation between parent and offspring. Genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism.	MS Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. MS Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.	
MS Students describe the evidence that evolution occurs over many generations, allowing species to acquire many of their unique characteristics or adaptations. MS Explain how the layers of sedimentary rock and their contained fossils provide evidence for the long history of Earth and	LS 4 The fossil record documents the existence, diversity, extinction, and change of many life forms and their environments through Earth's history. The fossil record and comparisons of anatomical similarities between	MS Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. MS Apply scientific ideas to construct an	

for the long history of changing life. MS Describe how small differences between parents and offspring can lead to descendants who are very different from their ancestors. MS Describe how variations in the behavior and traits of an offspring may permit some of them to survive a changing environment. MS Explain that new varieties of cultivated plants and domestic animals can be developed through genetic modification and describe the impacts of the new varieties of plants and animals. MS Students differentiate among organisms based on biological characteristics and identify patterns of similarity. MS Explain how biologists use internal and external anatomical features to determine relatedness among organisms and to form the basis for classification systems. MS Explain ways to determine whether organisms are the same species.	organisms enables the inference of lines of evolutionary descent. Both natural and artificial selection result from certain traits giving some individuals an advantage in surviving and reproducing, leading to predominance of certain traits in a population. Species can change over time in response to changes in environmental conditions through adaptation by natural selection acting over generations. Traits that support successful survival and reproduction in the new environment become more common. Changes in biodiversity can influence humans' resources and ecosystem services they rely on.	explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. MS Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. MS Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. MS Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. MS Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	
MS Students describe physical and chemical properties of matter, interactions and changes in matter, and transfer of energy through matter. MS Describe that all matter is made up of atoms and distinguish between/among elements, atoms, and molecules. MS Describe how physical characteristics of elements and types of reactions they undergo have been used to create the Periodic Table. MS Describe the difference between physical and chemical change. MS Explain the relationship of the motion	PS 1 The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter. Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.	MS Develop models to describe the atomic composition of simple molecules and extended structures. MS Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. MS Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. MS Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus	NGSS makes the connections between waves the creation of digital information.

of atoms and molecules to the states of matter for gases, liquids, and solids. MS Explain and apply the understanding that substances have characteristic properties, including density, boiling point, and solubility and these properties are not dependent on the amount of matter present. MS Use the idea of atoms to explain the conservation of matter. MS Explain how atoms are packed together in arrangements that compose all substances including elements, compounds, mixtures, and solutions.		mass is conserved.	
MS Describe and apply an understanding of the effects of multiple forces on an object, and how unbalanced forces will cause changes in the speed or direction. MS Describe and apply an understanding of how electric currents and magnets can exert force on each other.	PS 2 The role of the mass of an object must be qualitatively accounted for in any change of motion due to the application of a force. Forces that act at a distance involve fields that can be mapped by their relative strength and effect on an object.	MS Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.* MS Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. MS Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. MS Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. MS Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	
MS Describe and apply an understanding of how the gravitational force between any two objects would change if their	PS 3 Kinetic energy can be distinguished from the various forms of potential energy.	MS Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass	

mass or the distance between them changed. MS Describe and apply an understanding of how electric currents and magnets can exert force on each other. MS Describe and apply an understanding of the effects of multiple forces on an object, and how unbalanced forces will cause changes in the speed or direction. MS Students describe physical and chemical properties of matter, interactions and changes in matter, and transfer of energy through matter.	Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter. When two objects interact, each one exerts a force on the other, and these forces can transfer energy between them. Sunlight is captured by plants and used in a reaction to produce sugar molecules, which can be reversed by burning those molecules to release energy.	of an object and to the speed of an object. MS Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. MS Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.	
MS Students describe the force of gravity, the motion of objects, the properties of waves, and the wavelike property of energy in light waves. MS Describe the similarities and differences in the motion of sound vibrations, earthquakes, and light waves. MS Explain the relationship among visible light, the electromagnetic spectrum, and sight. HS Describe [and apply – still aligned to HS]characteristics of waves including wavelength, frequency, and amplitude.	PS 4 A simple wave model has a repeating pattern with a specific wavelength, frequency, and amplitude, and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena including sound and light. Waves can transmit energy. Waves can be used to transmit digital information. Digitized information is comprised of a pattern of 1s and 0s.	MS Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. MS Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. MS Integrate qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	
NOT currently ASSESSED on MEA but included in 2007 MLR MS Students use a systematic process, tools, equipment, and a variety of materials to design and produce a solution or product to meet a specified need, using established criteria. MS Identify appropriate problems for technological design. MS Design a solution or product.	Engineering Design	MS Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and	Engineering Design in not currently assessed in the MEA but is a part of the Maine science standards.

MS Communicate a proposed design using drawings and simple models. MS Implement a proposed design. MS Evaluate a completed design or product. MS Suggest improvements for their own and others' designs and try out proposed modifications. MS Explain the design process including the stages of problem identification, solution design, implementation, and evaluation.		constraints of the problem. MS Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	
Grade Span 9-12: High School			
HS Students explain the physical formation and changing nature of our universe and solar system, and how our past and present knowledge of the universe and solar system developed. HS Explain the role of gravity in forming and maintaining planets, stars, and the solar system. HS Outline the age, origin, and process of formation of the universe as currently understood by science. HS Describe the major events that have led to our current understanding of the universe and the current technologies used to further our understanding. HS Describe how light is emitted and absorbed by atoms' changing energy levels, and how the results can be used to identify a substance. HS Students understand that the laws of force and motion are the same across the universe. Students describe the role of science and technology in creating and solving contemporary issues and challenges. HS Describe and analyze the effects of biological and geophysical influences on	HS ESS 1 Light spectra from stars are used to determine their characteristics, processes, and lifecycles. Solar activity creates the elements through nuclear fusion, and short-term solar variations cause space weather and insolation changes that significantly affect humanity. The development of technologies has provided the astronomical data that provide the empirical evidence for the Big Bang theory. Kepler's laws describe common features of the motions of orbiting objects. Observations from astronomy and space probes provide evidence for explanations of solar system formation. Changes in Earth's tilt and orbit cause climate changes such as Ice Ages. The rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations.	HS Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. HS Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. HS Communicate scientific ideas about the way stars, over their life cycle, produce elements. HS Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.	

the origin and changing nature of Earth Systems. HS Describe and analyze the effect of solar radiation, ocean currents, and atmospheric conditions on the Earth's surface and the habitability of Earth. HS Describe Earth's internal energy sources and their role in plate tectonics.			
HS Describe Earth's internal energy sources and their role in plate tectonics. HS Students describe and analyze the biological, physical, energy, and human influences that shape and alter Earth Systems. HS Describe and analyze the effects of human influences on Earth Systems. HS Describe and analyze the effects of biological and geophysical influences on the origin and changing nature of Earth Systems. Describe and analyze the effect of solar radiation, ocean currents, and atmospheric conditions on the Earth's surface and the habitability of Earth. Explain the essential roles of carbon and water in life processes. HS Describe the critical role of photosynthesis and how energy and the chemical elements that make up molecules are transformed in ecosystems and obey basic conservation laws. HS Explain how the variation in structure and behavior of a population of organisms may influence the likelihood that some members of the species will have adaptations that allow them to survive in a	HS ESS 2 Feedback effects exist within and among Earth's systems. Radioactive decay and residual heat of formation within Earth's interior contribute to thermal convection in the mantle. The planet's dynamics are greatly influenced by water's unique chemical and physical properties. The role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Global climate models are used to predict future changes, including changes influenced by human behavior and natural factors. The biosphere and Earth's other systems have many interconnections that cause a continual co- evolution of Earth's surface and life on it.	HS Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. HS Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems. HS Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. HS Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. HS Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. HS Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.	

changing environment.			
NOT currently ASSESSED on MEA but included in 2007 MLR HS Students describe the role of science and technology in creating and solving contemporary issues and challenges. HS Explain how science and technology influence the carrying capacity and sustainability of the planet. HS Explain how ethical, societal, political, economic, and cultural factors influence personal health, safety, and the quality of the environment.	ESS 3 Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits. Natural hazards and other geological events have shaped the course of human history at local, regional, and global scales. Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies and regulations. Global climate models used to predict changes continue to be improved, although discoveries about the global climate system are ongoing and continually needed.	HS Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. HS Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* HS Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. HS Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* HS Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. HS Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.	The NGSS puts the focus on how resources and hazards guiding the development of human society.
HS Students describe structure and function of cells at the intracellular and molecular level including differentiation to form systems, interactions between cells and their environment, and the impact of cellular processes and changes on individuals. HS Describe the similarities and differences in the basic functions of cell	LS 1 Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors. Growth and division of cells in organisms	HS Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. HS Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	

membranes and of the specialized parts within cells that allow them to transport materials, capture and release energy, build proteins, dispose of waste, communicate, and move. HS Describe the relationship among DNA, protein molecules, and amino acids in carrying out the work of cells and how this is similar among all organisms. HS Describe the interactions that lead to cell growth and division (mitosis) and allow new cells to carry the same information as the original cell (meiosis). HS Describe the role of regulation and the processes that maintain an internal environment amidst changes in the external environment. HS Describe the process of metabolism that allows a few key biomolecules to provide cells with necessary materials to perform their functions. HS Describe the critical role of photosynthesis and how energy and the chemical elements that make up molecules are transformed in ecosystems and obey basic conservation laws.	occurs by mitosis and differentiation for specific cell types. The hydrocarbon backbones of sugars produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.	HS Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. HS Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. HS Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. HS Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. HS Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.	
HS Students describe and analyze the interactions, cycles, and factors that affect short-term and long-term ecosystem stability and change. HS Explain why ecosystems can be reasonably stable over hundreds or thousands of years, even though populations may fluctuate. HS Describe dynamic equilibrium in ecosystems and factors that can, in the long run, lead to change in the normal pattern of cyclic fluctuations and apply that knowledge to actual situations. HS Explain the concept of carrying	LS 2 Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem. Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem elements are combined in	HS Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. HS Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. HS Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.	Energy was integrated into the 2007 MLR. It is explicitly addressed in the NGSS. One could make the case that it is included in the first MLR statement for this section.

capacity and list factors that determine the amount of life that any environment can support. HS Describe the critical role of photosynthesis and how energy and the chemical elements that make up molecules are transformed in ecosystems and obey basic conservation laws. HS Explain how the variation in structure and behavior of a population of organisms may influence the likelihood that some members of the species will have adaptations that allow them to survive in a changing environment. HS Students describe and analyze the evidence for relatedness among and within diverse populations of organisms and the importance of biodiversity. HS Describe how cells differentiate to form specialized systems for carrying out life functions.	different ways and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle. If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem. Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.	HS Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. HS Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere HS Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. HS Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.* HS Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	
HS Students examine the role of DNA in transferring traits from generation to generation, in differentiating cells, and in evolving new species. HS Explain some of the effects of the sorting and recombination of genes in sexual reproduction. HS Describe genes as segments of DNA that contain instructions for the cells and include information that leads to the differentiation of cells. HS Explain how the instructions in DNA that lead to cell differentiation result in varied cell functions in the organism and DNA. HS Describe the possible causes and effects of gene mutations.	LS 3 DNA carries instructions for forming species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ The variation and distribution of traits in a population depend on genetic and environmental factors. Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.	HS Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. HS Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. HS Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	

HS Students describe the interactions between and among species, populations, and environments that lead to natural selection and evolution. HS Describe the premise of biological evolution, citing evidence from the fossil record and evidence based on the observation of similarities within the diversity of existing organisms. HS Describe the origins of life and how the concept of natural selection provides a mechanism for evolution that can be advantageous or disadvantageous to the next generation. HS Explain why some organisms may have characteristics that have no apparent survival or reproduction advantage. HS Relate structural and behavioral adaptations of an organism to its survival in the environment. HS Students describe and analyze the evidence for relatedness among and within diverse populations of organisms and the importance of biodiversity. HS Explain how the variation in structure and behavior of a population of organisms may influence the likelihood that some members of the species will have adaptations that allow them to survive in a changing environment. HS Describe the role of DNA sequences in determining the degree of kinship among organisms and the identification of species. HS Analyze the relatedness among organisms using structural and molecular evidence. HS Analyze the effects of changes in biodiversity and predict possible consequences.	LS 4 The ongoing branching that produces multiple lines of descent can be inferred by comparing DNA sequences, amino acid sequences, and anatomical and embryological evidence of different organisms. Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population. Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means that the distribution of traits in a population, as well as species expansion, emergence or extinction, can change when conditions change. Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth.	HS Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. HS Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. HS Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. HS Construct an explanation based on evidence for how natural selection leads to adaptation of populations. HS Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. HS Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*	

HS Students describe the structure, behavior, and interactions of matter at the atomic level and the relationship between matter and energy. HS Describe the structure of atoms in terms of neutrons, protons, and electrons and the role of the atomic structure in determining chemical properties. HS Describe how the number and arrangement of atoms in a molecule determine a molecule's properties, including the types of bonds it makes with other molecules and its mass, and apply this to predictions about chemical reactions. HS Describe nuclear reactions, including fusion and fission, and the energy they release. HS Describe radioactive decay and half-life.	PS 1 The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter, including chemical reactions and nuclear processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart.	HS Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. HS Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. HS Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. HS Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. HS Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. HS Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	
HS Describe factors that affect the rate of chemical reactions (including concentration, pressure, temperature, and the presence of molecules that encourage interaction with other molecules). HS Apply an understanding of the factors that affect the rate of chemical reaction to predictions about the rate of chemical reactions.	PS 2 Chemical processes are understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved. Newton's 2nd law (F=ma) and the conservation of momentum can be used to predict changes in the motion of macroscopic objects.	HS Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. HS Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. HS Apply scientific and engineering ideas to design, evaluate, and refine a device	

		that minimizes the force on a macroscopic object during a collision.* HS Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. HS Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. HS Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*	
HS Apply an understanding of energy transformations to solve problems. HS Describe the relationship among heat, temperature, and pressure in terms of the actions of atoms, molecules, and ions. HS Describe how in energy transformations the total amount of energy remains the same, but because of inefficiencies (heat, sound, and vibration) useful energy is often lost through radiation or conduction. HS Explain the relationship between kinetic and potential energy and apply the knowledge to solve problems. HS Describe kinetic energy (the energy of motion), potential energy (dependent on relative position), and energy contained by a field (including electromagnetic waves) and apply these understandings to energy problems. Students understand that the laws of force and motion are the same across the universe. Describe the contribution of Newton to our understanding of force and motion,	PS 3 The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of fields or interactions of particles. Systems move toward stable states. Fields contain energy that depends on the arrangement of the objects in the field. Photosynthesis is the primary biological means of capturing radiation from the sun; energy cannot be destroyed, it can be converted to less useful forms.	HS Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. HS Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields. HS Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.* HS Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). HS Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces	

and give examples of and apply Newton's three laws of motion and his theory of gravitation. Explain and apply the ideas of relative motion and frame of reference.		between objects and the changes in energy of the objects due to the interaction.	
Describe how light is emitted and absorbed by atoms' changing energy levels, and how the results can be used to identify a substance. Describe and apply an understanding of how waves interact with other waves and with materials including reflection, refraction, and absorption. Describe and apply characteristics of waves including wavelength, frequency, and amplitude. Describe the relationship between electric and magnetic fields and forces, and give examples of how this relationship is used in modern technologies.	PS 4 The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy. Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common applications of electromagnetic radiation. Large amounts of information can be stored and shipped around as a result of being digitized.	HS Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. HS Evaluate questions about the advantages of using a digital transmission and storage of information. HS Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.	
NOT currently ASSESSED on MEA but included in 2007 MLR HS Students use a systematic process, tools and techniques, and a variety of materials to design and produce a solution or product that meets new needs or improves existing designs. HS Identify new problems or a current design in need of improvement. HS Generate alternative design solutions. Select the design that best meets established criteria. HS Use models and simulations as prototypes in the design planning process. HS Implement the proposed design solution.	Engineering Design	HS Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS Use a computer simulation to model the impact of proposed solutions to a	

HS Evaluate the solution to a design problem and the consequences of that solution. HS Present the problem, design process, and solution to a design problem including models, diagrams, and demonstrations.		complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	

Maine Standards (performance indicators and descriptors) not aligned to Disciplinary Core Ideas.

K-2

List living things and their parts. Explain that parts of living are so small we can only see them using magnifiers.

K-2 Describe the life cycle of a plant or animal (including being born, growing, reproducing, and dying). Describe how organisms change during their lifetime.

Students describe similarities and differences between present day and past organisms that helped the organisms live in their environment.

Explain how some kinds of organisms that once lived on Earth have completely disappeared, although they were similar to some that are alive today.

3-5

Describe the kinds of materials that form rocks and soil.

Explain how the substance called air surrounds things, takes up space, and its movement can be felt as wind.

Students describe how living things are made up of one or more cells and the ways cells help organisms meet their basic needs.

Give examples of organisms that consist of a single cell and organisms that are made of a collection of cells.

Compare how needs of living things are met in single-celled and multi-celled organisms.

Describe what happens to the temperatures of objects when a warmer object is near a cooler object.

6-8

MS Identify some of the risks to the healthy development of an embryo including mother's diet, lifestyle, and hygiene.

HS

HS Explain why the unit of light years can be used to describe distances to objects in the universe and use light years to describe distances.

HS Explain how ethical, societal, political, economic, religious, and cultural factors influence the development and use of science and technology.

HS Describe ways in which cells can malfunction and put an organism at risk.

Explain the essential roles of carbon and water in life processes.